Vapor Control System Evaluation Report

Village of Hartford
Hartford, Illinois

Clayton Project No. 15-03095.11
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1.0 INTRODUCTION

The overall goal of this evaluation program was focused on evaluating the potential for interim optimization of the Vapor Control System (VCS) and not large-scale expansion of the system. Furthermore, it is recognized that additional investigation of the nature and extent of the contamination within the Village of Hartford will be necessary before full-scale implementation of a remedy can be initiated.

Results from the preliminary investigation of the VCS performance (conducted in July 2003) indicate there is little airflow and vacuum influence on the subsurface at the existing vapor control borings (VCB). However, the cause for this reduction in system efficiency was not determined at that time. It was suspected the VCBs may be clogged, therefore reducing airflow and vacuum influence from each VCB.

The evaluation activities proceeded in a phased approach in accordance with the VCS Evaluation Work Plan dated October 14, 2003. Four (4) vapor control borings (VCBs) were inspected and/or tested during the initial phase of this evaluation. These VCBs were VCB-1, VCB-6, VCB-8, and VCB-12 as shown on Figure 1. These VCBs were chosen for further evaluation since three of them were originally evaluated (VCB-1, VCB-6, and VCB-12) and had vapor monitoring probes located nearby. VCB-08 was added to evaluate the eastern side of the system.

The following report details the activities conducted to obtain additional information, conclusions, and recommendations for further activities to evaluate and/or optimize the performance of the VCS system.

2.0 VCS EVALUATION ACTIVITIES

Clayton began the onsite evaluation activities on Monday, October 20, 2003. The initial plan was to begin with the excavation of two of the VCBs (1 & 6), conduct the appropriate tests, and move on to the next two VCBs.

However, after meeting with Premcor on the first day, they indicated that all of the VCBs would need to be blind flanged at the control butterfly valve so that there was no connection to the treatment system on the Premcor property. Since the blower and treatment equipment were on the Premcor property, health and safety concerns with the potential for sparking during excavation required that each VCB be isolated prior to excavation.

Clayton revised its approach to removing the control valves from all four of the VCBs and installing blind flanges at one time in order to minimize system downtime. This work was conducted on Monday, October 20, 2003 and completed on Tuesday, October 1, 2003. USEPA was contacted regarding the change in sequencing and approved the change.

Prior to any work on the VCS system (i.e., shutdown of the system for blind flange installations), all of the VCB wells were monitored for vacuum and flow rate. Additionally, the vacuum at the blower compound was also measured. Table 1 presents the baseline data collected. Clayton also measured the vacuum influence at the vapor monitoring probes located near VCB-1, VCB-6, and VCB-12. Table 2 presents the results of these measurements.

2.1 VCB EXCAVATION

The next step involved the excavation of all of the four selected VCBs prior to replacing the valves and conducting the flow and vacuum testing. Excavation began on Tuesday, October 21, 2003 and continued through Wednesday, October 22, 2003. Steel plates were placed on the excavations in the street (i.e., VCB-6, VCB-8, and VCB-12) at the end of each day.

Excavation began at VCB-1. The initial plan was to excavate all the way down to the 3-inch ID connection piping so they could be inspected. However, during the excavation of VCB-1, it became apparent that excavating down to that depth in each location would require additional time and shoring to complete the testing. Clayton determined all of the testing that was planned could be conducted with access to only the top of each well, in turn requiring that the excavations would only be about 4 feet deep. Clayton informed USEPA of the change and proceeded to excavate only to the top of the wells at VCB-6, VCB-8, and VCB-12.

While conducting the excavation on VCB-12, a sanitary sewer line was discovered directly on top of VCB-12. The sanitary sewer line was observed to be leaking at the time of the excavation. Photos included in the report show the proximity of the sewer line to VCB-12. Due to the proximity of the sewer line to VCB-12, the plans for testing VCB-12 were discontinued. The sanitary line was repaired, and the excavation backfilled with gravel to surface grade.

Soils excavated from each location were placed in lined roll-off boxes. The boxes are currently stored at the Premcor facility pending disposal as special waste. These soils were removed from the Premcor facility on Wednesday, October 29, 2003 for proper offsite disposal.

2.2 VISUAL OBSERVATIONS OF SYSTEM

The first well to be excavated and opened was VCB-1 just south of Birch Street. After removing the blind flange on the top of the well, Clayton measured the depth of the well and any liquid present. The total depth for VCB-1 was approximately 31.3 feet, and the depth to water in the well was 24.56 feet. These measurements were taken from the top of the well casing, which is approximately 3 feet below surface grade. No separate-phase product was observed or measured in the well.

Clayton observed in VCB-1 a substantial amount of material clogging the inside of the well screen as far down the well as could be observed. A sample of the material was scraped out of the well and observed further. The material was orange-to-brown in color and the consistency of dry peanut butter. A distinct petroleum odor was present in the material. Clayton was unable to observe the outside of the well and/or the filter sock, but it seems evident from the fouling on the inside of the well that the screen and filter sock are clogged as well.

A similar fouling was observed in VCB-6. Separate-phase product was observed in VCB-6 at a depth of 26.82 feet from the top of the well, with water at approximately 27.1 feet.

VCB-8 was not opened and observed during the evaluation program. Although VCB-8 was excavated, testing at VCB-6 indicated vacuum loss was occurring at the system equipment. It was decided that inspection of VCB-8 was not necessary because VCB-1 and VCB-6 had similar observed internal screen fouling.

2.3 VACUUM AND FLOW TESTING

On Thursday, October 23, 2003, Clayton began vacuum and flow testing of VCB-6. Photos of the test apparatus are included in this report. With the control valve completely open, the vacuum measured in VCB-6 was 100 inches of water column (WC). A differential pressure over the orifice flow meter was measured at 4.1 inches WC, which equates to an airflow rate of approximately 101 standard cubic feet per minute (scfm). Vacuum measured at the wellhead was 50 inches WC.

With the air dilution valve open at VCB-6, the measured vacuum at the control vault was 40 inches WC and a differential pressure over the orifice meter of > 8 inches WC. This converts to an airflow rate of > 158 scfm through the piping. Vacuum measured at the wellhead was 20 inches WC. Flow rate measured at the wellhead using a pitot tube was approximately 174 scfm.

On Friday, October 24, 2003, Clayton conducted vacuum and flow testing on VCB-1. Prior to testing the vacuum at the control vault was 22 inches WC with a differential pressure of ~0.1 inches resulting in an approximate airflow rate of between 10 and 20 scfm. Vacuum measured at the wellhead was 20 inches WC.

2.4 VCS EQUIPMENT EVALUATION

After completing the vacuum and flow testing at VCB-6 and VCB-1, Clayton moved to the blower and treatment equipment to continue the evaluation of the VCS. The previous testing indicated the 3-inch ID pipelines from the wells seem to be in good working order with no clogs. However, during the flow testing at the VCBs (dilution valve open at each wellhead), Clayton observed the vacuum at the wellhead and on the upstream side of the detonation flame arrester decreased while the vacuum downstream of the arrester remained virtually unchanged. This preliminarily indicated there may be vacuum loss over the flame arrester. Because of this, the system has been operated with air dilution valve half-open to keep the VCS from exceeding its maximum operating limit (145 inches WC).

In addition, the blower was observed to shut down frequently due to high vacuum when the VCBs were blinded at the beginning of the week. A spill back valve (recirculation of discharge air from the blower) was opened to reduce the vacuum on the system and keep the system operating. Clayton began its investigation of the VCS equipment by removing and inspecting the dilution valve air filter. The air filter was clogged, and Clayton replaced the filter. After installing the new air filter, the spill back valve could be closed while still allowing the appropriate amount of air to maintain the system vacuum.

At the end of the first week, Clayton also observed that the pressure drop over the detonation flame arrestor was over 10 inches Hg (130 inches WC). Clayton scheduled to remove and inspect the detonation flame arrestor the following week and determine if this may be causing the vacuum problem.

On October 28, 2003, Clayton had the system shut down and supervised the removal of the detonation flame arrestor. The arrestor is made up of two components. The first is what is commonly referred to as a "witches hat." This is conical-shaped filter screen designed to capture larger particles from reaching the arrestor element. This filter was clogged and was able to be cleaned.

Next, the flame arrestor element (stainless steel) was removed and inspected. Clayton observed a majority of the element was clogged to airflow with materials similar to those observed in the VCB wells. Clayton attempted to clean the element with carburetor cleaner. The element was allowed to soak with limited success. After cleaning, Clayton supervised the reinstallation of the flame arrestor and restart of the system. The system vacuum before cleaning was 130 inches WC. After cleaning, the system vacuum was the same.

Clayton also reviewed the system components to determine the ability to obtain flow measurements from the system to continue operation of the system and optimize based on field conditions. Some vacuum gauges were available to determine pressure drop, but the system does not have alarm capabilities if the pressure drop increases over the acceptable value. Furthermore, no flow measurement for the air dilution is available. This is necessary to confirm the operating parameters of the system while operating. No data logging capabilities exist for these measurements as well as the operating parameters for the thermal treatment unit.

3.0 CONCLUSIONS

The onsite testing and evaluation completed between October 20 and October 29, 2003 by Clayton has provided sufficient information regarding the issues with the VCS system operation. Although vacuum extraction tests were not conducted on the VCBs, the information obtained from the other tests concluded that further vacuum testing would likely results in the same conclusions.

The following conclusions were made based on the above-referenced testing:

1. VCB-6 and VCB-1 were visually clogged and indicated they were substantially clogged through the testing conducted. It is concluded that the outside of the well screens and the filter socks are clogged at each VCB.

2. The connection piping (3-inch ID) from the wells to the control vaults was not impacted and would allow sufficient airflow if the dilution valve could be shut allowing the blower to produce the appropriate airflow within the VCBs.

3. The air filter on the dilution air valve was clogged before inspection and replacement. This clogged filter limited the ability of the system to take in dilution air to maintain the appropriate system vacuum. A new air filter was installed.

4. The detonation flame arrestor was clogged causing the majority of the vacuum loss in the system. Cleaning of the existing element was ineffective. Cleaning of the “witch’s hat” was effective.

5. Minimal operating parameters can be measured at the equipment compound. No data logging or alarm capabilities are currently available on the system to confirm performance and be alerted to system operational problems.

4.0 RECOMMENDATIONS

The current VCS system is not operating at optimum efficiency and has little influence beyond approximately 25 feet from each well. As indicated in Section 3.0, Clayton believes this is due to two primary issues:

1. All of the VCB well screens and surrounding filter socks are clogged (with hydrocarbon residue, subsurface silts, and biological fouling) and not allowing sufficient airflow to produce the necessary vacuum influence; and,

2. The detonation flame arrestor and other components are not in good working order to allow for the optimum vacuum and flow rate from the VCBs.

Based on the information obtained during this project, several recommendations for additional evaluation have been developed. The following sections describe in more detail the recommended activities.

4.1 VAPOR EXTRACTION WELLS

Two options exist for the rehabilitation of the existing 12 vapor extraction wells. The first is to attempt some type of cleaning and ongoing maintenance of the system to eliminate the clogging. A second option is to replace the wells at each existing location.

In evaluating the option of cleaning the well screens and filter sock, it is apparent this would not work effectively due to the attempts to clean the flame arrestor element that had similar material. Even with the use of a solvent (which could not be used in the wells), the arrestor element could not be cleaned effectively.

In order to determine if replacing the existing vapor extraction wells will make any difference to the existing conditions, a SVE pilot test (see discussion below) will need to be completed. This test should be conducted near VCB-1. The pilot test will determine if the radius of influence generated by the VCS can be increased with the installation of new wells.

To evaluate other technologies that may be used as part of the full-scale remedy in the Village of Hartford, a multi-phase extraction pilot test is recommended. Multi-phase extraction can be useful in enhancing the removal of separate-phase hydrocarbons from the water table. Multi-phase extraction is defined as removal of separate-phase product along with vapors to enhance the recovery efficiency. Several different configurations can be employed based on the nature and extent of the separate-phase as well as the type of geology. Although the full nature and extent of the separate-phase is not known at the present time, it is observed that minor amounts of separate-phase are not known at the present time, and it is observed that minor amounts of separate-phase have been present in RW-1 (i.e., less than a few tenths of a foot in thickness). For these situations, multi-phase extraction using a drop pipe to collect water, separate-phase, and vapors is generally employed to enhance separate-phase recovery. Based on the observed separate-phase product levels in RW-1 of less than half a foot in thickness, a multi-phase extraction test at RW-1 is recommended. The conduct of the test will require access agreements to be worked out with the current property owner(s).

In addition to the above-mentioned pilot tests, a separate-phase recovery test should be conducted using existing recovery wells (RW-2 and RW-3). This test will focus on determining how much separate-phase product can be recovered from wells within the Village of Hartford using conventional pumping techniques.

The following sections provide more information on the soil vapor extraction pilot test, the multi-phase extraction test, and the separate-phase recovery test.

4.2 SOIL VAPOR EXTRACTION PILOT TEST

A soil vapor extraction (SVE) pilot test is recommended in the Village of Hartford to evaluate the expected influence from a vapor extraction system. The existing system is not operating at the flow rates measured at the time the system was brought online. However, no influence measurements were made at the time the system became operational. The SVE pilot test would provide the necessary data required to determine the maximum expected radius of influence from an SVE well. The pilot testing will be conducted in accordance with the Army Corps of Engineers guidance EM 1110-1-4001 – Soil Vapor Extraction and Bioventing, dated June 2002.

The pilot test would be conducted near VCB-1. This location is chosen because it is isolated within a fenced property owned by Premcor and has existing shallow and deep vapor monitoring probes. A 4-inch-diameter well will be installed within approximately 5 feet of the VCB-1 so that the vapor monitoring probes can be utilized during the pilot test.

The pilot test well would be completed to a depth at least 2 feet above the average high water elevation. The well will be finished above grade such that the testing apparatus can be connected during the pilot test. Well screen will extend from the bottom of the borehole up to approximately 7 feet below ground surface. A 0.020-inch slot stainless-steel screen will be installed with a solid carbon steel riser to the surface.

A skid-mounted SVE unit will be used to conduct the pilot test. The unit will be equipped a with a positive displacement vacuum blower and liquid knockout vessel/pump to remove any entrained water.

The pilot test will be conducted in a step-wise fashion beginning with a low airflow rate and increasing to the capacity of the well or blower. The operating parameters of the

SVE module and select field test parameters will be measured at regular intervals during the pilot test. It is expected that the well will be tested at 25, 50, 75, 100, and 125 scfm. Higher flow rates may also be tested depending on the influence data obtained from the 125-scfm test and the capacity of the blower.

Each of the "steps" (different flow rate at the well) will be conducted between 2 and 4 hours each. During each step test, SVE parameters will be recorded approximately every 15 minutes. Existing VCB-01 control valve will be closed prior to commencement of the pilot testing on the new well. VCB-01 will remain off during all testing and will be opened again at the end of the pilot test.

The operating parameters of the SVE module and the field test parameters that will be measured during the pilot test are listed below.

- Airflow rate and vacuum at the extraction well.
- Influent air stream temperature.
- Relative organic vapor concentration of the influent air stream (prior to air dilution).
- Airflow rate and temperature of the exhaust air stream.
- Relative organic vapor concentration of the exhaust.
- Vacuum response at each monitoring probe.

The airflow rate at the SVE well will be measured to determine the subsurface airflow conditions at the extraction well. The air velocity will be measured using a pitot tube connected to a Magnehelic® gauge to measure differential pressure. The airflow velocity will then be converted to a standard airflow rate based on the cross-sectional area of the process pipe and a standard air density of 0.075 lbs/ft^3.
The vacuum, total (exhaust) airflow rate, and exhaust temperature at the SVE unit will be measured to determine the performance of the blower relative to the subsurface soils and extraction well design, the airflow loss between the extraction well and inlet of the SVE

unit, and the overall operating system performance. The airflow velocity of the exhaust air stream will be measured using a pitot tube connected to a Magnehelic® gauge to measure differential pressure (as previously described with the influent airflow rate). The vacuum will be measured directly using a vacuum gauge positioned in the water trap (post ADV) of the SVE unit. The exhaust temperature will be measured at the SVE exhaust stack via a fixed thermometer tapped into the side of the exhaust stack.

The vacuum response will be measured at each vapor monitoring probe (both shallow and deep) to determine the vacuum distribution or radius of influence of the extraction well. The vacuum levels will be measured using Magnehelic® negative pressure gauge. Readings will be taken by temporarily attaching a quick-connect fitting to a quick coupling attached to the top of each monitoring probe. The accuracy of the vacuum gauges is approximately ± 0.02 inches water column (W.C.).

Air samples will be collected from the influent air stream (prior to air dilution) and the exhaust air stream to monitor the influent concentrations. The air samples will be collected using Summa canisters. The air samples will be analyzed for total petroleum hydrocarbons (TPH) as gasoline per modified EPA Method TO-3 using a gas chromatograph equipped with a flame ionization detector. Samples will be collected from the two locations identified above at 30 minutes into the step test and at the end of the step test for each flow rate tested. Any water generated during the pilot test will be tested for the "Skinner List" (see Table 3) to determine if any residual treatment will be necessary for entrained water.

Water generated during the operation of the pilot testing will be transported to the Premcor facility for treatment in the onsite treatment system. Soil cuttings generated during the installation of the extraction test well will be transferred to a roll-off box or drums for proper disposal.

A pilot test report will be prepared detailing all of the test procedures implemented and the results of the testing. Analytical results from the air and water (if any) samples will be included in the report.

A schedule for conducting the SVE pilot test is being developed. This schedule will be dependent on comments and approval received from the USEPA and the Illinois EPA.

4.3 MULTI-PHASE EXTRACTION PILOT TEST

A multi-phase extraction (MPE) pilot test is recommended in the area of RW-1, pending resolution of access with the property owner. It should be clear that the current VCS system is not likely to be capable of upgrading to a multi-phase extraction system. However, for evaluating technologies for the full-scale remedy in the Village of Hartford, further evaluation of multi-phase extraction is necessary. The pilot test outlined below will be conducted in accordance with the Army Corps of Engineers guidance EM 1110-1-4010 – Multi-Phase Extraction, dated June 1999.

To prepare for the MPE pilot test, a 4-inch-diameter well will be installed near RW-1. This well will be constructed of 0.020-inch slot stainless-steel screen and carbon steel riser. The well will be set approximately 10 feet below the water table (~35 feet deep) with the screen extending to 7 feet below ground surface. A typical setup in the extraction well is shown in Figure 2.

Five nested vacuum monitoring probes and five piezometers will need to be installed for monitoring the MPE pilot test. The vacuum monitoring probes should be installed similar to those installed at VCB-1, VCB-6, and VCB-12. The probes should be constructed of one-inch PVC screen (0.010-inch slot size) and riser. The nested pair should consist of a shallow probe to a depth of approximately 10 feet below ground surface and an adjacent deep probe to a depth about 2 to 4 feet above groundwater (approximately 30 feet below ground surface).

The piezometers should be installed at the same total depth as the MPE pilot test well. Each piezometer will be constructed of 2-inch-ID PVC, 0.010-inch slot screen and solid PVC riser. The piezometer screen will be installed to at least 5 feet above the current groundwater elevation. Each piezometer will be flush-mounted.

A liquid-ring vacuum blower will be used to conduct the MPE pilot test. The unit will be self-contained and skid-mounted. The unit will have onboard capabilities of separating the water/vapor stream and directing the water to a storage tank.

The pilot test will be conducted in a step-wise fashion beginning with a low vacuum and increasing to the capacity of the well or blower. The operating parameters of the MPE module and select field test parameters will be measured at regular intervals during the pilot test.

Each of the "steps" (different vacuum at the well) will be conducted for a 24-hour period. During each step test, MPE parameters will be recorded approximately every 15 minutes. Groundwater elevation in the piezometers will be measured using pressure transducers and a datalogger. Readings on the datalogger will be taken every 1 to 10 seconds throughout the test.

The operating parameters of the MPE module and the field test parameters that will be measured during the pilot test are listed below:

- Vacuum at the extraction well.
- Vacuum at the inlet to the gas/liquid separator.

- Airflow rate on the dilution air at wellhead.
- Airflow rate downstream of the gas/liquid separator.
- Relative organic vapor concentration of the exhaust air stream (after gas/liquid separation).
- Airflow rate and temperature of the exhaust air stream.
- Temperature of the exhaust air stream.
- Groundwater elevation response at each piezometer (via pressure transducers and datalogger).
- Volume of water/product separated from gas phase.
- Depth to water and product in both test well and piezometers prior to step test.
- Depth to water and product in both test well and piezometers immediately following the step test.
- Vacuum response at each monitoring probe.

The airflow rate after the gas/liquid separation will be measured to determine the subsurface airflow conditions at the extraction well. The air velocity will be measured using a pitot tube connected to a Magnehelic® gauge to measure differential pressure. The airflow velocity will then be converted to a standard airflow rate based on the cross-sectional area of the process pipe and a standard air density of 0.075 lbs/ft^3.

The vacuum, total (exhaust) airflow rate, and exhaust temperature at the MPE unit will be measured to determine the performance of the blower relative to the subsurface soils and extraction well design, the airflow loss between the extraction well and inlet of the MPE unit, and the overall operating system performance. The airflow velocity of the exhaust air stream will be measured using a pitot tube connected to a Magnehelic® gauge to measure differential pressure (as previously described with the influent airflow rate). The vacuum will be measured directly using a vacuum gauge positioned at the inlet to gas/liquid separator (post ADV) of the MPE unit. The exhaust temperature will be measured at the MPE exhaust stack via a fixed thermometer tapped into the side of the exhaust stack.

The vacuum response will be measured at each vapor monitoring probe (both shallow and deep) to determine the vacuum distribution or radius of influence of the extraction well. The vacuum levels will be measured using Magnehelic® negative pressure gauge. Readings will taken by temporarily attaching a quick-connect fitting to a quick coupling attached to the top of each monitoring probe. The accuracy of the vacuum gauges is approximately $\pm$ 0.02 inches water column (W.C).

Groundwater elevation measurements in the piezometers will be obtained using downhole pressure transducers connected to a datalogger. Depth to water measurements will be collected via the pressure transducers continuously during each "step."

Water and separate-phase product volume generated during each "step" will be measured to correlate with the groundwater elevation measurements and the thickness of the separate-phase product in the well.

Air samples will be collected from the exhaust air stream (following gas/liquid separation), to monitor the effluent VOC concentrations. The air samples will be collected using Summa canisters. The air samples will be analyzed for total petroleum hydrocarbons (TPH) as gasoline per modified EPA Method TO-3 using a gas chromatograph equipped with a flame ionization detector. Samples will be collected from exhaust at 30 minutes into the step test and at the end of the step test for each vacuum tested. Water generated during each pilot step test will be analyzed for the "Skinner List" (see Table 3) to determine if any residual treatment will be necessary for recovered water.

Water generated during the operation of the pilot testing will be transported to the Premcor facility to be treated in the onsite treatment system. Soil cuttings generated during the installation of the extraction test well be transferred to a roll-off box or drums for proper disposal.

A pilot test report will be prepared detailing all of the test procedures implemented and the results of the testing. Analytical results from the air and water (if any) samples will also be included in the report.

A schedule for conducting the MPE pilot test is being developed. This schedule will be dependent on comments and approval received from the USEPA and the Illinois EPA and obtaining access from the owner(s) of the property in the area of RW-1.

4.4 SEPARATE-PHASE RECOVERY TEST

A separate-phase recovery test should be implemented using existing recovery wells (RW-2 and RW-3). Each recovery well will be outfitted with a submersible, pneumatic pump that is capable of collecting separate-phase only (top-filling). A double-walled tank (providing secondary containment) will be located at each recovery well to collect separate-phase. Each tank will be fitted with a float switch to shut off the pump when the tank is full.

The recovery test will be conducted for 3 months. Each well and pump will be monitored once per week throughout the test period. The thickness of separate-phase product will be measured in each well weekly. Additionally, the volume of product generated will be measured and product removed from the tanks as necessary.

Monthly updates on the progress of the recovery test will be prepared and submitted throughout the test. A final report of findings will be prepared at the end of the 3-month test period. Results of the product thickness measurements and volume generated will be included.

Based on the results of the separate-phase recovery test at RW-2 and RW-3, a vacuum enhanced recovery test may be recommended.

A schedule for conducting the separate-phase recovery test is being developed. This schedule will be dependent on comments and approval received from the USEPA and the Illinois EPA.

4.5 VCS SYSTEM EQUIPMENT

A replacement element for the detonation flame arrestor will need to be installed on the system to reduce the vacuum loss. Two replacement elements were ordered by Clayton with an expected lead-time of 4 to 6 weeks. The element has been delivered and will be schedule for replacement in mid-December 2003. The second element will be kept as a backup.

4.6 ONGOING OPERATION & MAINTENANCE

It is recommended that operation and maintenance (O&M) be revised to provide more frequent monitoring of system performance and ongoing maintenance of the system components. A new operations and maintenance manual should be developed to revise the O&M requirements and frequency. It is further recommended that the O&M activities be conducted by personnel other than the Premcor staff at the facility. Coordination of these activities will be necessary with Premcor due to its location at the active facility. It is anticipated with a more aggressive O&M program and appropriate monitoring that the system will perform at optimal conditions.

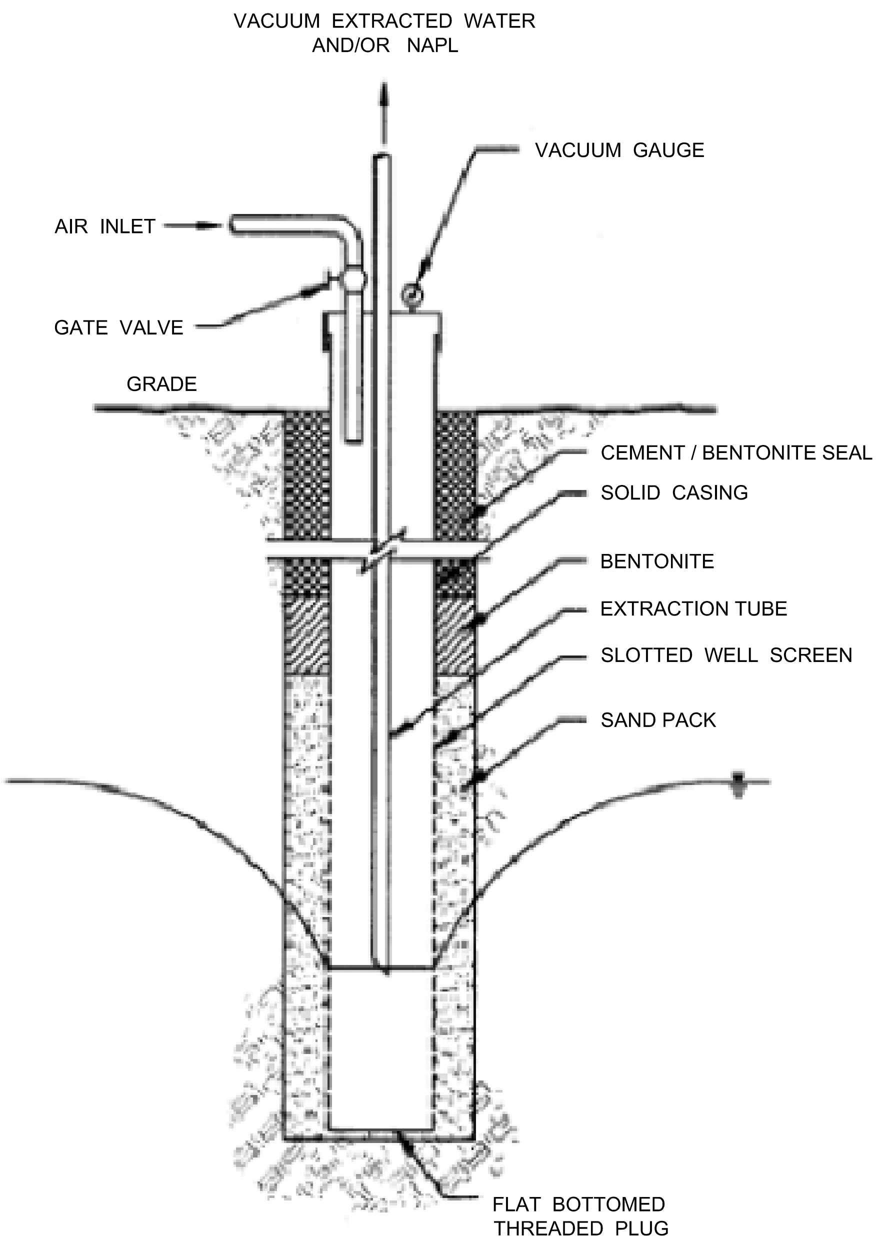
FIGURES

TABLES

PHOTOGRAPHS

APPENDIX A

VCS EVALUATION DAILY REPORTS



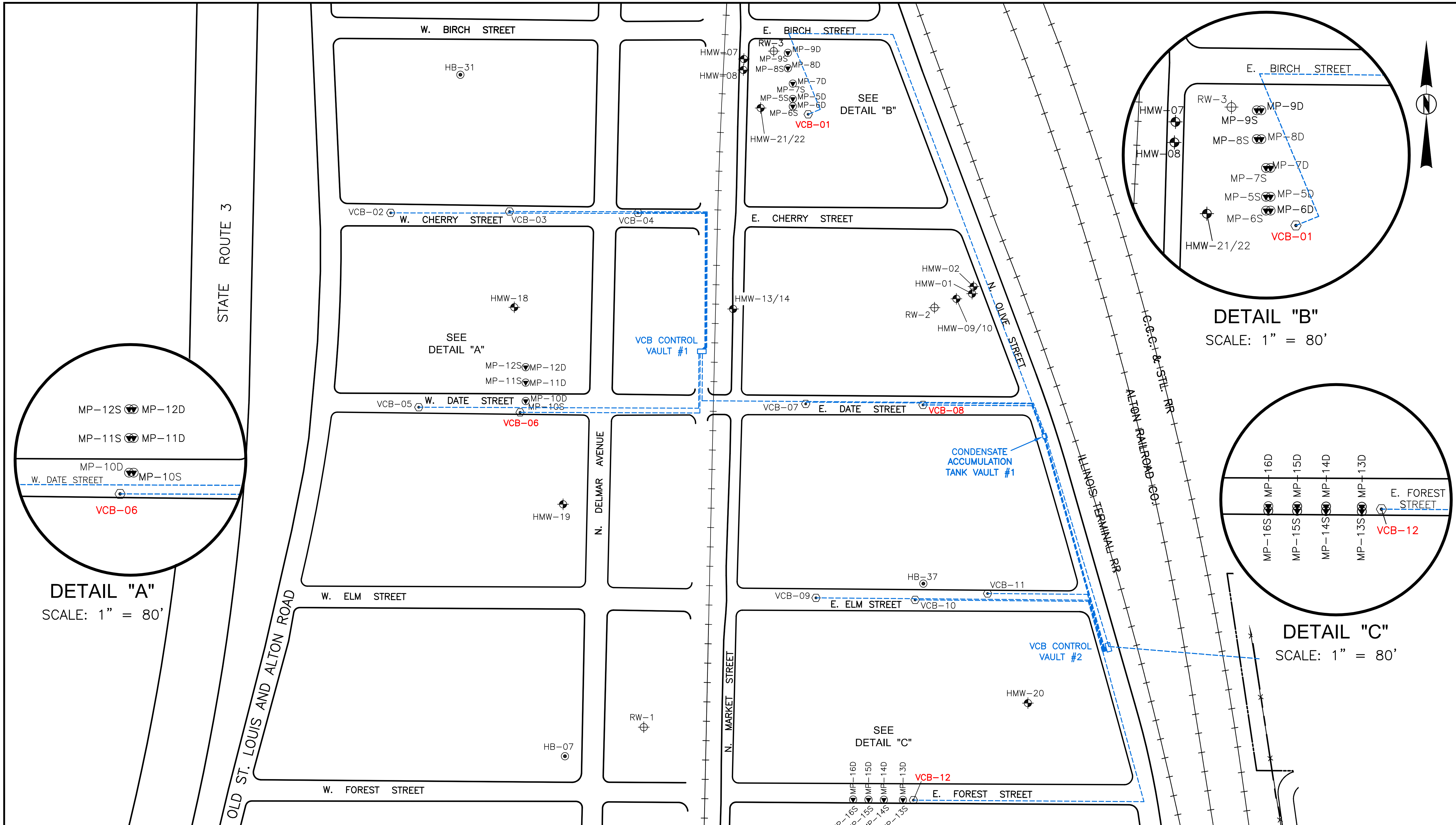
CHECK BY	MMN
DRAWN BY	BCP
DATE	12-3-03
SCALE	AS SHOWN
CAD NO.	0309511B
PRJ NO.	15-03095.11

TYPICAL MULTI-PHASE EXTRACTION WELL
CROSS SECTION

HARTFORD WORK GROUP
HARTFORD, ILLINOIS

Clayton® GROUP SERVICES

FIGURE
2



LEGEND

- SOIL VAPOR MONITORING PROBE (MP)
- MONITORING WELL (HMW)
- MONITORING WELL (HB)
- VAPOR CONTROL BORING (VCB)
- RECOVERY WELL (RW)
- VAPOR CONTROL LINES

NOTE:

SOIL VAPOR MONITORING PROBES (MP) INSTALLED BY CLAYTON ON JULY 23-25, 2003. REMAINING WELLS AND BORINGS INSTALLED BY OTHERS.

SCALE IN FEET

0 75 150 300

CHECK BY	JLP
DRAWN BY	BCP
DATE	10-6-03
SCALE	AS SHOWN
CAD NO.	0309511001A
PRJ NO.	15-03095.11

VILLAGE OF HARTFORD
VAPOR CONTROL BORING LOCATIONS

THE HARTFORD WORK GROUP
HARTFORD, ILLINOIS

Clayton GROUP SERVICES

FIGURE

1

TABLE 3

Skinner List

Hartford Working Group
Hartford, Illinois

PARAMETER	PREPARATION METHOD	ANALYTICAL METHOD	COMPOUND
VOCs			
	-	8260B	Benzene
	-	8260B	Carbon disulfide
	-	8260B	Chlorobenzene
	-	8260B	Chloroform
	-	8260B	1,2-Dichlorobenzene
	-	8260B	1,3-Dichlorobenzene
	-	8260B	1,4-Dichlorobenzene
	-	8260B	1,1-Dichloroethane
	-	8260B	1,2-Dichloroethane
	SW 8015	8260B	1,4-Dioxane
	-	8260B	Ethylbenzene
	-	8260B	Ethylene dibromide (EDB)
	-	8260B	Methyl ethyl ketone (MEK)
	-	8260B	Methyl tertiary butyl ether (MTBE)
	-	8260B	Styrene
	-	8260B	Toluene
	-	8260B	1,1,1-Trichloroethane
	-	8260B	Trichloroethene
	-	8260B	Tetrachloroethylene
	-	8260B	Xylenes (total)
SVOCs			
	3510C	8310	Acenaphthene
	3510C	8310	Anthracene
	3510C	8310	Benzo(a)anthracene
	3510C	8310	Benzo(b)fluoranthene
	3510C	8310	Benzo(k)fluoranthene
	3510C	8310	Benzo(a)pyrene
	3510C	8270C	Bis(2-ethylhexyl)phthalate
	3510C	8310	Chrysene
	3510C	8270C	o-Cresol
	3510C	8270C	m-Cresol
	3510C	8270C	p-Cresol
	3510C	8310	Dibenz(a,h)anthracene
	3510C	8270C	Di-n-butyl phthalate
	3510C	8270C	Diethyl phthalate
	3510C	8270C	2,4-Dimethylphenol
	3510C	8270C	Dimethyl phthalate
	3510C	8270C	2,4 Dinitrophenol
	3510C	8310	Fluoranthene
	3510C	8310	Fluorene
	3510C	8310	Indeno(1,2,3-cd)pyrene
	3510C	8310	Napthalene
	3510C	8270C	4-Nitrophenol
	3510C	8310	Phenanthrene
	3510C	8270C	Phenol
	3510C	8310	Pyrene
	3510C	8270C	Pyridine
	3510C	8270C	Quinoline

TABLE 3

Skinner List

Hartford Working Group
Hartford, Illinois

PARAMETER	PREPARATION METHOD	ANALYTICAL METHOD	COMPOUND
Metals			
	SW 3020B	SW 7000G	Antimony
	SW 3020B	SW 7000G	Arsenic
	SW 3020B	SW 6010B	Barium
	SW 3020B	SW 6010B	Beryllium
	SW 3020B	SW 6010B	Cadmium
	SW 3020B	SW 6010B	Chromium-Total
	SW 3010A	SW 6010B	Cobalt
	-	9014	Cyanide Total
	SW 3020B	SW 7000G	Lead
	-	SW 7470A	Mercury
	SW 3020B	SW 6010B	Nickel
	SW 3020B	SW 7000G	Selenium
	SW 3020B	SW 6010B	Silver
	SW 3020B	SW 6010B	Vanadium
	SW 3020B	SW 6010B	Zinc

NOTES:
VOC, SVOC, and Metal Groundwater compound/analytes based on USEPA Region 5 Waste Management Branch “Skinner List” Constituents of Concern for Wastes from Petroleum Processes.

TABLE 2
VCS Evaluation
Village of Hartford, Illinois

Summary of Baseline Vacuum Influence at VCBs

VCB Location	Vapor Monitoring Probe	Distance from VCB *(ft)*	Vacuum *(in WC)*
1	MP6D	13	0.75
1	MP5D	25	(1.3)
1	MP7D	50	0.15
1	MP8D	75	0.25
1	MP9D	100	0.25
6	MP10D	18.5	1.75
6	MP11D	48.5	0.1
6	MP12D	73.5	0
12	MP13D	17	2.5
12	MP14D	48	0
12	MP15D	73	0.15
12	MP16D	98	0

TABLE 1
VCS Evaluation
Village of Hartford, Illinois

Summary of Baseline VCB Vacuum & Flow

VCB Location	Vacuum *(in WC)*	Diff Pressure *(in WC)*	Flow *(scfm)*
1	100	1.2	55
2	100	0	0
3	100	0.5	35
4	100	0.6	39
5	100	0.4	32
6	100	4.3	105
7	100	0	0
8	108	0.4	32
9	100	0.1	12
10	100	0.2	23
11	100	0.15	17
12	100	0.3	27

Vacuum at blower was 7.5 in Hg (102 in WC)

Clayton Project No. 15-03095.11	Description	Excavation of VCB-1	1
	Site Name	Village of Hartford, Illinois	Date
	Client	Hartford Work Group	10/20/2003

Clayton Project No. 15-03095.11	Description	Excavation of VCB-6	2
	Site Name	Village of Hartford, Illinois	Date
	Client	Hartford Work Group	10/20/2003

Clayton Project No. 15-03095.11	Description	Road Plate Installation at VCB-6	3
	Site Name	Village of Hartford, Illinois	Date
	Client	Hartford Work Group	10/21/2003

Clayton Project No. 15-03095.11	Description	Excavation of VCB-8	4
	Site Name	Village of Hartford, Illinois	Date
	Client	Hartford Work Group	10/21/2003

Clayton Project No. 15-03095.11	**Description**	VCB-12 Excavation with Sanitary Sewer	**5**
	Site Name	Village of Hartford, Illinois	**Date**
	Client	Hartford Work Group	10/22/2003

Clayton Project No. 15-03095.11	**Description**	Sanitary Sewer Line Repaired in VCB-12	**6**
	Site Name	Village of Hartford, Illinois	**Date**
	Client	Hartford Work Group	10/23/2003

Clayton Project No. 15-03095.11	**Description**	Interior of VCB-1 with Fouling	**7**
	Site Name	Village of Hartford, Illinois	**Date**
	Client	Hartford Work Group	10/22/2003

Clayton Project No. 15-03095.11	**Description**	Interior of VCB-6 with Fouling	**8**
	Site Name	Village of Hartford, Illinois	**Date**
	Client	Hartford Work Group	10/23/2003

Clayton Project No. 15-03095.11	Description	Test Apparatus on VCB-1	9
	Site Name	Village of Hartford, Illinois	Date
	Client	Hartford Work Group	10/22/2003

Clayton Project No. 15-03095.11	Description	Detonation Flame Arrestor Element	10
	Site Name	Village of Hartford, Illinois	Date
	Client	Hartford Work Group	10/28/2003

Clayton Project No. 15-03095.11	**Description**	Detonation Flame Arrestor Element During Cleaning	**11**
	Site Name	Village of Hartford, Illinois	**Date** 10/20/2003
	Client	Hartford Work Group	

Clayton Project No. 15-03095.11	**Description**	Witches Hat from Flame Arrestor	**12**
	Site Name	Village of Hartford, Illinois	**Date** 10/28/2003
	Client	Hartford Work Group	

VCS SYSTEM EVALUATION
Daily Report

DATE: 10-20-2003

CLAYTON PROJECT No.: 15-03095.11-001

LOCATION: Hartford, Illinois

DESCRIPTION OF ACTIVITIES:

Clayton began the day by meeting with Premcor personnel to discuss required safety procedures for the work to be conducted in the Village of Hartford on the Vapor Control System (VCS). During discussions it became evident that the sequence to excavating and testing the wells would need to modified to conform with the health & safety requirements for the VCS system operation.

Excavation cannot be conducted while the system was operational due to concerns with sparking at the wellhead. Prior to excavation, each well to be tested will require to have its control valve removed and a blind flange installed. Once excavation is complete and all test apparatus is connected, the system valve would be reinstalled. The sequence was modified to conduct the excavation at all four VCB locations first, followed by testing at each location. This will likely result in completion of only the excavations the first week and completion of the VCB testing during Week 2.

Prior to any system shutdown, Clayton obtained current measurements of vacuum and flow at each VCB and measured vacuum influence at vapor monitoring probes located near VCB-1, 6 & 12. At approximately 15:30 the VCS system was shutdown to begin the removal of the valves and installation of the blind flanges. Removal of the valve was difficult due to the age of the valves and was completed for only three of the four VCBs (1, 8 & 12). The VCS system was brought back online at approximately 21:00 after completion of work for the day.

PROPOSED ACTIVITIES FOR NEXT DAY:

Clayton will begin with the shutdown of the VCS system and begin the removal of the final valve and installation of blind flange (VCB-6). At the VCB locations where the blind flange was installed, the second Clayton crew will begin excavation. It is anticipated the excavation will begin at VCB-1. Soil will be loaded into lined, roll-off boxes and will be temporarily stored at the Premcor facility each night until disposal can be arranged.

Once excavations are completed for each VCB, new valves will be reinstalled in the control vaults to replace the temporary blind flanges.

Organizations Onsite: Clayton, GRP Mechanical (Clayton Subcontractor), Premcor, TetraTech (USEPA Oversight)

VCS SYSTEM EVALUATION
Daily Report

DATE: 10-21-2003	
CLAYTON PROJECT No.: 15-03095.11-001	
LOCATION: Hartford, Illinois	

DESCRIPTION OF ACTIVITIES:

Clayton continued work on removing valves and blinding VCB-6 in preparation for excavation. This work was completed by noon. Excavation was completed at VCB-1 to uncover the wellhead and piping. After excavating to at least 8 feet below ground surface without observing the 3-inch diameter connection piping at VCB-1, it was decided to backfill the excavation to just below the wellhead to allow for access to connect the testing apparatus.

Based on the potential depth of the excavation, Clayton determined that all of the required testing could be conducted with only access to the wellhead. The testing planned would allow for the determination of any system leaks in the pipeline without daylighting the connections. Clayton will compare the airflow reading from the control vault with those obtained at the wellhead and will be able to determine if there is leakage from the piping or connections. Clayton reviewed this modification with the USEPA onsite oversight contractor (TetraTech) and with USEPA and obtained approval for this approach.

In the afternoon excavations were completed on both VCB-6 and VCB-8 along Date Street. Following exposure of the wellhead in excavation, road plates will placed over the top of each excavation and barricades placed at each of the corners before the end of the day. The excavation at VCB-1 is within the fenced property owned by Premcor, therefore barricades and caution tape was used to secure this excavation.

Due to the dimensions of the wellhead flanges, attachments are being fabricated that will allow mating of the wellhead flange to the test apparatus flange. The wellhead and VCS system components utilize 300 psi fitting and materials that are not compatible with the standard 150 psi fittings on the test equipment. The fabricated connection involves welding a 300 psi flange to a 150 psi flange fitting that can then be connected to each wellhead.

PROPOSED ACTIVITIES FOR NEXT DAY:

Clayton plans complete the excavation at VCB-12 (the final VCB) and begin the connection of the testing apparatus to VCB-1 in preparation of the test. After all connections are made at the wellhead, VCS will be shutdown again and the blind flange from VCB-1 will be replaced either with the original valve or a new valve in preparation for the well testing.

Clayton anticipates testing VCB-1 either late afternoon or Thursday depending on the time to set up the apparatus and replace the valve.

Organizations Onsite:

Clayton
GRP Mechnanical (Clayton subcontractor)
Premcor
TetraTech (USEPA Oversight)
Illinois EPA

VCS SYSTEM EVALUATION
Daily Report

DATE: 10-22-2003	
CLAYTON PROJECT No.: 15-03095.11-001	
LOCATION: Hartford, Illinois	

DESCRIPTION OF ACTIVITIES:

Clayton began the excavation at VCB-12 to uncover the wellhead. During the excavation, a sewer lateral was found directly above the wellhead with signs that it had been previously repaired. No utility marking was located in this area. According to Jim Hickerson with the Village of Hartford, he was present when the sewer was hit the first time during installation of the well. Furthermore, he indicated that the village does not mark these laterals because they do no know where they are. Mr. Hickerson indicated that the sewer line was repaired during the initial installation. However, the line is currently observed to be leaking. Based on the presence of the pipeline directly above the wellhead, Clayton will not conduct the planned testing since access to the top of the well is impossible with the sewer line present.

On VCB-1 (the first well to be tested), Clayton removed the wellhead blind flange and conducted a visual inspection prior to connection of the test apparatus. The visual inspection indicated that major fouling of the internal portions of the well screen has occurred in the bottom 2/3rds of the well. The fouling was orange and brown and was clinging to the inside surface of the well screen. A similar material had been observed on October 21, 2003 in the connection piping at the control vault as the control valve was being removed. Total depth in the well was measured at 31.4 feet compared to a design depth of 32 feet. Water was present in the well at 24 feet below the top of the wellhead with no measurable separate-phase product.

Replacement valves for all four VCBs arrived late in the day to be installed once all excavation is complete. Test apparatus installation on VCB-1 was completed. The excavation at VCB-12 was covered with a steel traffic plate and barricades.

PROPOSED ACTIVITIES FOR NEXT DAY:

Clayton plans to temporarily shutdown the VCS so that the new valves can be installed on the four VCBs. Once the valves are reinstalled, Clayton will begin it's testing on VCB-1, followed by the visual inspection of VCB-6, connection of the test equipment and testing. It is anticipated that the testing of both VCB-1 and VCB-6 can be completed by the end of the day.

At VCB-12, the top of the wellhead will be uncovered and photographed for future reference. Repair of the sanitary sewer line will be completed and the excavation backfilled to surface grade.

Organizations Onsite: Clayton
GRP Mechanical (Clayton subcontractor)
Premcor
TetraTech (USEPA Oversight)

VCS SYSTEM EVALUATION
Daily Report

DATE: 10-23-2003

CLAYTON PROJECT No.: 15-03095.11-001

LOCATION: Hartford, Illinois

DESCRIPTION OF ACTIVITIES:

Clayton worked on uncovering VCB-12 and the sanitary sewer line in order to make repairs. Repairs to the sanitary sewer line were made and the excavation backfilled to surface grade with gravel.

On VCB-6, Clayton opened the wellhead and visually inspected the inside of the well. The inside had similar fouling, but was not as widespread as in VCB-1. The second set of test apparatus was setup on VCB-6 and the first vacuum test was run at VCB-6 instead of VCB-1. Separate-phase product was observed in the well and measured at a depth of 27 feet below the top of the wellhead. Approximately 1.5 to 2 feet of product were present in the well.

The preliminary test results indicated that there was substantial flow in the pipeline between the well and the control vault (>150 cfm) when ambient air was allowed to enter the system at the wellhead. This result indicates that the 3-inch pipeline from the wells does not seem to be impeding the flow. Measurement of vacuum and flow at the wellhead and control vault were comparable indicating that the well is potentially not causing the reduction in influence. Little influence beyond about 25 feet from VCB-6 was measured.

PROPOSED ACTIVITIES FOR NEXT DAY:

Clayton plans continue testing on VCB-1. Following conduct of the wellhead testing, Clayton will evaluate the activities proposed for the following week.

Organizations Onsite:
Clayton
GRP Mechanical (Clayton subcontractor)
Premcor
TetraTech (USEPA Oversight)

VCS SYSTEM EVALUATION
Daily Report

DATE: 10-24-2003	
CLAYTON PROJECT No.: 15-03095.11-001	
LOCATION: Hartford, Illinois	

DESCRIPTION OF ACTIVITIES:

Clayton worked continued with testing of VCB-1. Results indicated that there was good airflow through the pipeline at VCB-1 even with the observed materials in the pipeline. During the testing it was noted that when the valve was opened on VCB-1 the vacuum reduced to 20 inches of water column when the vacuum on the system was at about 100 inches of water column.

Investigation of the VCS blower unit indicated that the air dilution air filter was almost clogged and was causing the system to go off when no additional air could enter the system when the VCB valves were closed during the testing. The filter was cleaned and eliminated much of the problem. Additional measurements of the system operational parameters indicated that a high pressure drop was observed over the inline flame arrester. Although the arrester has been cleaned in the past, it may be clogged and causing a flow restriction.

VCB-6 and VCB-8 were left with plates over the excavations with barricades.

PROPOSED ACTIVITIES FOR NEXT DAY:

Clayton is planning to have the flame arrestor removed and inspection on Tuesday, October 28, 2003. If possible, Clayton will attempt to clean it and determine if any increased vacuum and flow results. If it does, Clayton will continue with its testing of VCB-1 and VCB-6. If increased capacity does not improve the vacuum influence at VCB-1 and/or 6, Clayton will prepare to arrange for a portable vacuum blower to be used at the site to conduct a pilot test. The vacuum truck previously proposed will not provide the required vapor flow at the well to provide the influence needed. Clayton also plans to continue its evaluation of the VCS system blower unit operation.

Organizations Onsite: Clayton
GRP Mechanical (Clayton subcontractor)
Premcor
TetraTech (USEPA Oversight)

VCS SYSTEM EVALUATION
Daily Report

DATE: 10-28-2003

CLAYTON PROJECT No.: 15-03095.11-001

LOCATION: Hartford, Illinois

DESCRIPTION OF ACTIVITIES:

Clayton supervised the removal, inspection, and cleaning of the detonation flame arrestor on the VCS. The flame arrestor is located on the vacuum side of the blower to prevent flames from traveling from the wells to the blower and from the thermal treatment unit to the wells. Inspection of the flame arrestor indicated that is was almost completely clogged with similar material found at each of the VCB wells. Prior to removing the arrestor, the differential pressure drop was about 10 inches of Hg. The manufacturers literature indicates that the pressure drop should only be about 2 to 3 inches of water column at the design system flow rates.

Clayton attempted to clean the arrestor element in order to evaluate the performance of the VCB wells. The cleaning operation was only partially successful. Due to the number and size of the openings in the arrestor element, it will be impossible to thoroughly clean the element. Clayton contacted the manufacturer regarding the purchase of new elements. An order was placed for two new arrestor elements with a lead-time of 4 to 6 weeks.

The partially cleaned arrestor element was reinstalled in the system and the VCS restarted. The resulting pressure drop over the arrestor was less than 1 inch of Hg.

PROPOSED ACTIVITIES FOR NEXT DAY:

Clayton is planning on conducting some additional testing on VCB-1 following the reinstallation of the partially cleaned arrestor element. Since more airflow is being allowed through the flame arrestor, Clayton will determine if the wells are producing more influence or may still be clogged due to the filter sock on each well.

Organizations Onsite: Clayton
GRP Mechanical (Clayton subcontractor)
Premcor
TetraTech (USEPA Oversight)

VCS SYSTEM EVALUATION
Daily Report

DATE: 10-29-2003	
CLAYTON PROJECT No.: 15-03095.11-001	
LOCATION: Hartford, Illinois	

DESCRIPTION OF ACTIVITIES:

Clayton conducted additional testing at VCB-1 following the reinstallation of the flame arrestor element the previous day. Although more flow was allowed through the system, the arrestor was still clogged. Tests at VCB-1 indicated that at least 50% more air was able to flow through the piping from the air dilution valve on the wellhead test apparatus. When this valve was closed, no increase in airflow and an increase in the vacuum were observed. Additionally, no increase in vacuum influence was measured in the vapor monitoring probes.

Clayton has ordered the flame arrestor replacement element with an expected delivery of between 4 and 6 weeks. Clayton has completed its planned work in the Village of Hartford. Plates remain in place over VCB-6 & 8. VCB-1 is secured with barricades within the fenced property south of Birch Street.

PROPOSED FUTURE ACTIVITIES:

As requested by the Hartford Work Group, Clayton will be preparing its draft report of findings for presentation to the group early next week. In addition, the report will include Clayton's recommendations for system optimization and a cost estimate in order for the group to evaluate the recommendation. No additional field activities are planned at this time.

Organizations Onsite: Clayton
GRP Mechanical (Clayton subcontractor)
Premcor
TetraTech (USEPA Oversight)